C

(11) (CA) No. 916204

(45) ISSUED Dec. 5, 1972

(52) CLASS 305-38
C.R. CL. 267-28

(10) CANADIAN PATENT

(54) SPRING UNIT FOR SNOWMOBILE SKI RUNNER ASSEMBLY

Jules Perreault and Claude Lemieux, Valcourt, Quebec, Canada

Granted to Bombardier Limited, Valcourt, Quebec, Canada

(21) APPLICATION No. 097,634
(22) FILED Nov. 6, 1970

(30) PRIORITY DATE

No. OF CLAIMS 10

DISTRIBUTED BY THE PATENT OFFICE, OTTAWA.
CCA-274

916204

The present invention relates to a ski assembly for use in a snowmobile and, more particularly, to that type of a snowmobile ski assembly which consists of a series of stacked spring leaves, the function of which is to provide resilience to the front end of the vehicle body.

Present ski assemblies used in snowmobiles consist mainly of a ski runner attached to a series of three or four spring leaves of different dimensions, stacked one upon the other and held together at their mid-portion by a spring clip secured to the lower end of a ski leg. Certain snowmobiles use only one ski assembly but the vast majority of present-day snowmobiles require two side-by-side units. The main spring leaf, the longest of the series, has its opposite ends mounted to the ski runner, one end being attached thereto in such a way as to take up the elongation of the spring leaf when deflecting. In order to limit the deflection of the spring leaves and to thereby prevent them from being overstressed, a rubber abutment is usually provided underneath the spring assembly to contact the top face of the ski runner upon a hard shock.

The main spring leaf and the auxiliary spring leaves together must operate with a certain degree of resilience; their spring characteristics are calculated so that shocks of average or normal extent may be absorbed. However, this type of shock absorbing system is quite inadequate for such conditions as when the snowmobile is traversing at a relatively high speed an uneven terrain and increased loads are imparted. It has been found that, under these conditions, the snowmobile is difficult to maneuver, lacking proper ground adhesion and good stability. On the other hand, the use of stiffer spring leaves and/or of a larger number

thereof was found to result in a harsh ride at lower speeds.

The present invention is directed primarily at increasing the load absorbing capacity of the ski assembly when the snowmobile is subjected to severe ground loading without affecting the characteristics of the spring assembly for deflections of small or medium amplitude. In accordance with the present invention, this result can be obtained by means of an auxiliary spring leaf which sets at work only after the main leaf spring unit has undergone a predetermined initial deflection. This, therefore, provides to the snowmobile a front suspension, the spring characteristics of which vary according to the load imparted and to the deflection thereby caused.

The present invention provides a ski assembly for use in a snowmobile or the like which comprises a ski runner having a top surface, a leaf spring unit including at least a full length semi-elliptic spring leaf longitudinally extending over the top surface of the ski runner and having its opposite ends connected thereto, and an auxiliary semi-elliptic spring leaf mounted onto the ski assembly in vertical alignment with the leaf spring unit in the space between the leaf spring unit and the ski runner; the auxiliary leaf spring is so dimensioned as to resist deflection only after the leaf spring unit has undergone a predetermined initial deflection.

In one embodiment of the invention, the auxiliary spring leaf has an intermediate central portion mounted in contact engagement with the central portion of the leaf spring unit and has its opposite end portions spaced from the full length spring leaf to thereby provide the clearance space required so that the auxiliary spring leaf may join in the absorbing action of the main spring

leaf unit only after a first downward deflection of the full length spring leaf.

In another embodiment, the central portion of the auxiliary spring leaf is vertically distanced from that of the main leaf spring unit, and has its opposite ends in contact with the top surface of the ski runner; again, the auxiliary spring leaf is flexed by the full length spring leaf only after a first deflection of the latter.

The invention itself together with other objects and advantages thereof will best be understood from the following description of specific embodiments thereof when read in connection with the accompanying drawings in which:

Fig. 1 is an exploded perspective side view of one embodiment of a ski assembly for use in a snowmobile;

Fig. 2 is a side view of the ski assembly shown in Fig. 1;

Fig. 3 is a cross-sectional view taken along lines 3-3 of Fig. 2;

Fig. 4 is a longitudinal cross-sectional view of another embodiment of a ski assembly in accordance with the present invention;

Fig. 5 is a perspective view of the connection of the front end of the auxiliary spring leaf with the ski runner.

Referring generally to the drawings wherein like reference characters designate like or corresponding parts throughout, there is shown a ski assembly 10 which is adapted to be mounted at the front end of a snowmobile (not shown) to provide the steering movement thereof; the ski assembly is fixed to a ski leg (not shown) linked to the steering column of the vehicle. There are

usually two of these assemblies mounted in laterally spaced relation supporting the front end of the vehicle body; however, some snowmobiles are steered with only one ski, centrally disposed at the front thereof.

Generally, the ski assembly 10 consists of a leaf spring unit 12 longitudinally extending over a ski runner 14 and having the extremities of its front and rear end portions 12a and 12b connected to the top surface of the ski runner.

The leaf spring assembly 12 is semi-elliptical and includes at least a main spring leaf 16 and two additional V-end spring leaves 18 and 20, the function of which is to reinforce the main spring leaf. The main spring leaf 16 is full length while the additional spring leaves 18 and 20 are shorter to each form a graduate leaf spring. It is evident that additional full length and/or graduate spring leaves may be added and that the number of spring leaves provided in a leaf spring unit in the final design will be determined by a series of parameters such as material, width, thickness, and even the shape of the ends of the graduate leaves.

In a preferred embodiment of the invention illustrated in Figs. 1, 2 and 3, an auxiliary semi-elliptic spring leaf 22 having a radius of curvature smaller than that of the spring leaf 16, is longitudinally mounted above the ski runner 14 and beneath the leaf spring unit 12; the spring leaf 22 is vertically aligned with the leaf spring unit 12 and has its intermediate central portion superposed in contact engagement with the central portion of the spring leaf unit 12. The opposite end portions 22a and 22b are vertically distanced from the spring leaf unit 12 and from the ski runner 14; however, it is well within the scope of this

invention to have an auxiliary spring leaf which would have a radius of curvature equal to that of the main spring leaf unit and thereby have its opposite end portions distanced from the ski runner only. In both cases, the auxiliary spring leaf will resist deflection only after its opposite end portions will have contacted the upper surface of the ski runner. The respective extremities of end portions 22a and 22b terminate in a plane substantially parallel to that of the ski runner and are each provided with rubber-like stoppers 23a and 23b to contact the top surface of the ski runner. A spring coupler 24 is bolted to the intermediate central portions of the spring unit 12 and of the auxiliary spring leaf 22; the coupler 24 is U-shaped, the bottom wall 25 of which receives bolts 26 and 28 therethrough and the side walls 30, 32 of which respectively have an aperture 33, 34 to receive a horizontally disposed retainer pin or bolt 35 to secure the ski assembly 10 to the ski leg (not shown) of the snowmobile.

The top surface of the ski runner 14 has a downwardly projecting U-shaped centre portion 36 extending almost the entire length thereof; the ground-engaging surface of the ski runner 14 is provided with a blade 38 secured by means, such as bolt 39 (see Fig. 4), to provide better gripping and lateral stability of the ski runner in the snow or ice. A bent bar 40 has its ends secured to the front curved portion of the ski runner for towing and lifting. Two longitudinally spaced anchoring brackets 42 and 44 receive the opposite ends of the full length spring leaf 16, the rear end of which is terminated in the shape of an eye 45 through which a retainer pin and cotter pin 47 fix the same to the ski runner. The front end extremity of the main spring leaf 16

terminates in an upwardly turned curve, the valley portion 48 of which is received in a slider cushion 50 held within the side walls of bracket 42 by retainer pin 52 and cotter pin 53; this end portion of the main spring leaf is slidably bearing on the bottom wall of member 50 so that the elongation of the main spring leaf may be taken up when the spring is downwardly deflected.

When the present ski assembly is mounted to a snowmobile running at normal speed, normal loads imparted to the front of the vehicle body will be absorbed by the leaf spring unit 12 which will flex readily and in the usual manner and the rubber stoppers 23a and 23b do not touch the upper face of ski runner 14. However, as the load increases due to increase in speed or to greater irregularities on the terrain, the downward deflection of leaf spring unit 12 will also increase to reach a point where stoppers 23a and 23b will contact the upper surface 55 of the U-shaped centre portion 36 of the ski runner. This contact will cause the upper surface 56 of the auxiliary spring leaf 22 to come into a face-to-face engagement with the undersurface 58 of the full length leaf spring 16. The overload which causes this deflection of the leaf spring unit onto the spring 22 in conjunction with spring unit 12 is thereafter absorbed by the spring leaf 22. There results a suitably yielding suspension having a double constant which is well adjusted to the load imparted to the front end of the snowmobile and which provides better riding comfort to the snowmobiler.

Referring now to the second preferred embodiment illustrated in Figs. 4 and 5, it will be understood that the same

reference characters are applied where appropriate to represent the same or similar components appearing in Figs. 1, 2 and 3 but are distinguished therefrom by the application of a prime mark. The principal difference in the second embodiment resides in A that the auxiliary spring leaf 22' has its opposite ends mounted on the upper surface 55' of the centre portion 36' of ski runner 14' by means of two longitudinally spaced welded anchoring brackets 60 and 62; the connection of the auxiliary spring leaf 22' to the ski runner 14' is similar to that of spring leaf 16' to the same ski runner. The rear extremity of the auxiliary spring leaf 22' is terminated in the shape of an eye 64 receiving a retainer pin 66 which anchors the spring to bracket 62. The front extremity of the leaf spring 22' is terminated in the shape of an upturned curve passing under a retainer pin 68 and slidably bearing on a copper or plastic cushion 70. The centre portion of the semi-elliptical spring leaf 22' is vertically aligned with that of the spring unit 12'. A wear-resistant pad 72 is secured to the undersurface of the full length spring leaf 16' at the centre portion thereof by appropriate securing means (not shown, but such as, for example, bolts 26 and 28 of the ski assembly shown in Fig. 1). There is left between the auxiliary spring leaf 22' and the full length spring leaf 16' a clearance space which extends for the entire length of the auxiliary spring leaf 22'.

Whereas in the embodiment illustrated in Figs. 1, 2 and 3, the radius of curvature of the semi-elliptic auxiliary spring leaf had to be smaller than or equal to that of the main spring leaf, no such restriction exists in the second embodiment

of the invention. It is quite conceivable to provide an auxiliary spring leaf 22' with a radius of curvature larger than that of spring leaf 16'.

The second embodiment of the invention functions to absorb the overload imparted on the ski assembly in substantially the same manner as described above in connection with the first embodiment shown in Figs. 1, 2 and 3. In this second embodiment, the operation of the auxiliary spring leaf to absorb the excess of loading, again, will begin only after a first downward deflection of the spring unit 12' and only when the pad 72 will have contacted the centre portion of spring leaf 22'. As the auxiliary spring leaf 22' begins to flex, the elongation thereof is taken up at bracket 60 where the front end portion of the spring leaf 22' slides on the cushion member 70.

Therefore, in both embodiments, the spring unit has a double constant: a first constant effective during the initial downward deflection of the leaf spring units 12, 12' a second constant effective during the further downward deflection of the spring units 12, 12' with auxiliary spring leaves 22, 22'. This second constant remains in operation until the upward return of springs 22, 22' to an undistorted position; then the first constant remains alone in operation until the spring units 12, 12' are no longer subjected to loads.

While the invention has been described above only in relation to two specific forms, persons skilled in the art will be aware that it may be refined and modified in various ways without departing from its scope. It is therefore wished to have it understood that this invention is not to be limited in interpretation except by the terms of the following claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A ski assembly for use in a snowmobile comprising a ski runner having a top surface; a leaf spring unit including at least a full length semi-elliptic spring leaf longitudinally extending over the top surface of said ski runner and having its opposite ends connected thereto and an auxiliary one-piece semi-elliptic spring leaf mounted onto said ski assembly in vertically alignment with the leaf spring unit in the space between said leaf spring unit and said ski runner, said auxiliary spring leaf being downwardly concave and having its central portion generally vertically aligned with the central portion of the said leaf spring unit, and said auxiliary leaf spring being connected to one of said ski runner or said leaf spring units such that in the rest condition of the ski assembly the auxiliary spring leaf is free of contact with the other of said leaf spring unit or ski runner, such that said auxiliary spring leaf contacts both said leaf spring unit and said ski runner to resist further deflection of the ski assembly only after the said leaf spring unit has undergone a predetermined initial deflection.

2. A ski assembly for use in a snowmobile comprising a ski runner having a top surface; a leaf spring unit including at least a full length semi-elliptic spring leaf longitudinally extending over the top surface of said ski runner and having its opposite ends connected thereto; and an auxiliary one-piece semi-elliptic spring leaf longitudinally mounted above the ski runner and beneath the full length spring leaf; said full length spring leaf and said auxiliary spring leaf being vertically aligned; said auxiliary spring leaf being downwardly

concave and having a central portion mounted in contact engagement with the central portion of said leaf spring unit and having its opposite end portions vertically distanced from the ski runner so as to leave a clearance space between said ends and the ski runner in the rest condition of the ski assembly, wherein said auxiliary spring leaf is downwardly flexed by said end portions of the auxiliary spring leaf contacting the top surface of said ski runner only after an initial downward deflection of said full length spring leaf.

3. A ski assembly as defined in Claim 2 wherein said auxiliary spring has a radius of curvature smaller than that of the full length spring leaf.

4. A ski assembly as defined in Claim 3 wherein said spring leaf unit further includes coupling means for securing the central portion of said auxiliary spring leaf to said central portion of said full length spring leaf.

5. A ski assembly as defined in Claim 4 wherein said auxiliary spring leaf is provided with stopper means at each end thereof to contact the top surface of said ski runner.

6. A ski assembly for use in a snowmobile comprising a ski runner having a top surface; a leaf spring unit including at least a full length semi-elliptic spring leaf longitudinally extending over the top surface of said ski runner and having its opposite ends connected to said top surface thereof; and an auxiliary one-piece downwardly concave semi-elliptic spring leaf longitudinally mounted above the ski runner and beneath the full length spring leaf and having its opposite ends secured to the top surface of said ski runner; said full length spring leaf and said auxiliary spring leaf being vertically

A

aligned and having their respective central portions vertically distanced from one another so as to leave a clearance space between said central portion in the rest condition of the ski assembly, wherein said auxiliary spring leaf is downwardly flexed upon contact of said central portion of said spring leaf unit with the central portion of said auxiliary spring leaf only after an initial downward deflection of said spring leaf unit.

7. A ski assembly as defined in Claim 6 further comprising a pair of anchoring brackets longitudinally spaced on the top surface of the ski runner and fixed thereto for securing the opposite ends of the auxiliary spring leaf one of said pair of brackets being adapted to slidably bear one extremity of the auxiliary spring leaf so as to take up the elongation thereof when flexed, the other end of said auxiliary spring leaf being pivotably mounted on the other end of said pair of brackets.

8. A ski assembly as defined in Claim 7 wherein a wear-resistant pad is secured to the central portion of said full length spring leaf to contact the central portion of said auxiliary spring leaf.

9. A ski assembly as defined in Claim 1, Claim 2 or Claim 6 wherein said ski runner is provided with a pair of longitudinally spaced anchoring means for connecting said full length spring leaf with said ski runner, one of said pair being adapted to slidably bear one end of said full length spring leaf in order to take up the elongation of said full length spring leaf upon deflection thereof.

10, A ski assembly as defined in Claim 1, Claim 2 or Claim 6 wherein said leaf spring unit further includes graduated spring leaves stacked in face-to-face engagement over said full length spring leaf to reinforce said full length spring leaf.

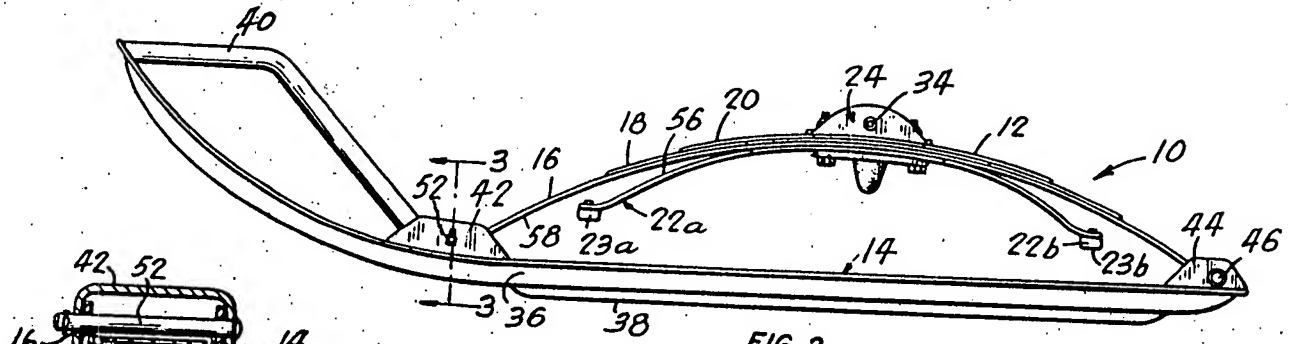

FIG. 2

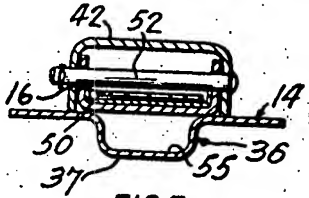

FIG. 3

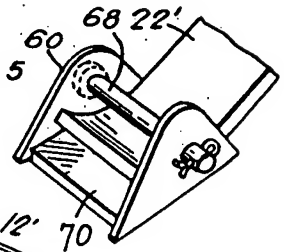

FIG. 5

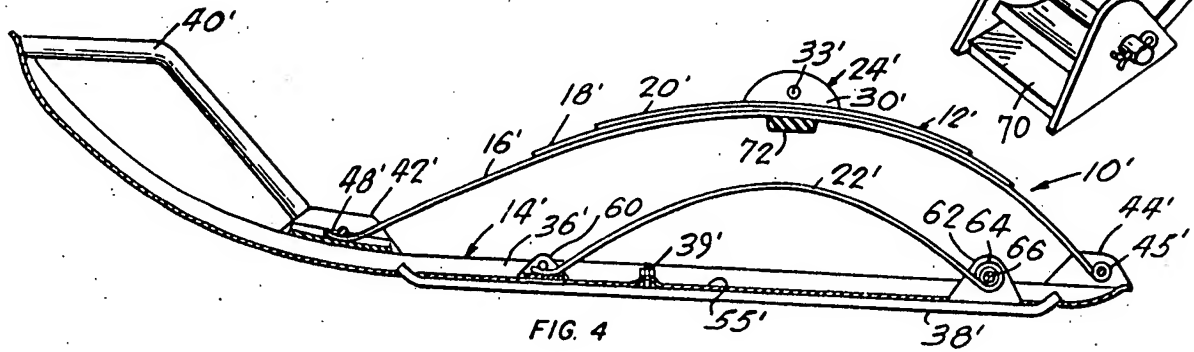

FIG. 4

916204

2-2

~~80~~
~~5R~~

916204
2-1

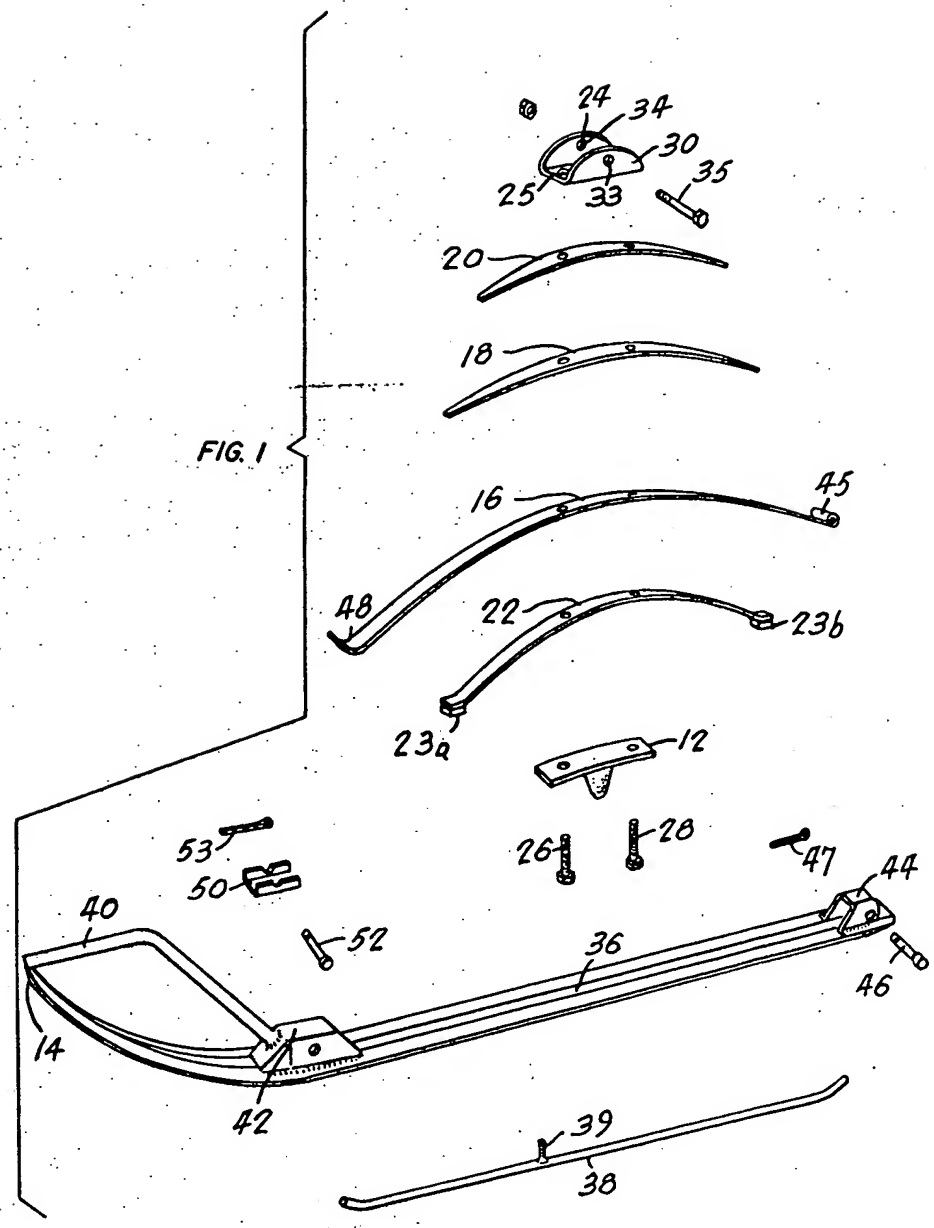

FIG. 1